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Effect of Variety on the Proximate and Sensory Properties of Wheat/Millet Cake

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Abstract The effect of variety on the proximate and sensory properties of wheat millet cakes was assessed. Cake samples were produced from varying compositions of flour from wheat/millet varieties (pearl, finger and fonio millet). Wheat was substituted with 10 to 40% millet and plain wheat used as control. The cakes were evaluated for proximate and sensory properties using standard methods. The proximate composition of different wheat/millet cake showed that moisture content ranged between 15.90-19.15% (pearl),15.61-19.15% (finger) and 12.52-19.15% (fonio millet), while ash content ranged between 1.0-2.05% (pearl), 1.90-2.49% (finger) and 0.70-2.05% (fonio millet). Fat content of cakes from flour blends ranged between 18-18.67% (pearl millet), 15.91-18.00% (finger millet) and 14.90-18.00% (fonio millet), while protein content ranged between 5.75-13.16% (pearl millet), 5.75-11.85% (finger millet) and 5.35-10.54% (fonio millet) respectively. Crude fibre content ranged between 1.32-2.00% (pearl millet), 1.67-3.00% (finger millet) and 0.68-1.67% (fonio millet), while carbohydrate content of wheat/millet cakes ranged between 44.72-51.72% (pearl millet), 43.51-51.16% (finger millet) and 34.34-48.83% (fonio millet). Sensory evaluation result of cakes from blends of wheat/millet varieties showed 4.60-8.05 (pearl), 3.65-8.30 (finger) and 5.65-7.80 (fonio) for color, while appearance values ranged from 5.10-7.80, 3.20-8.50 and 5.25-7.85 for finger, pearl and fonio blend respectively. Flavor ranged between 5.05-7.90, 4.30-7.70 and 5.15-7.80 for pearl, finger and fonio millet blends, while texture values ranged between 5.60-7.50 for pearl, 3.90-7.60 for finger and 4.80-7.55 for fonio millet blend respectively. Taste ranged from 5.20 -7.86, 4.09 -7.89 and 5.20-7.86, with overall acceptability of products ranging from 5.10-8.00, 4.35-7.75 and 5.65-7.80 for pearl, finger and fonio millet blends respectively. The substitution of different quantities of millet varieties for wheat flour caused a decrease in moisture, ash and fat contents with an increase in protein, fibre and carbohydrate with cake samples competing favorably with the wheat cake sample. The study has shown millet to have good potential for confectionary production.

Keywords: *Millet, varieties, cakes, proximate, sensory*

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1. Introduction

Cereals are important sources of the world's food supply and their role in human diet throughout the world is extremely vital FAO [1] with rice, barley, maize, wheat, sorghum, oat, rye and millet contributing to diets in the world.

Millets are small-seeded grains, belonging to the Poaceae (Graminaea) family [2]. They are cultivated in diverse and adverse environments, mostly in the dry, semi-arid to sub-humid, drought prone agro-ecosystem [3]. They are comparable or superior to some commonly consumed cereals like wheat and rice [4]. Millets have different varieties, but of interest to this location include pearl millet (Pennisetum glaucum), finger millet (Eleusine coracana), fonio (Digitaria exilis). Species of this crop are produced in large quantities in Borno, Yobe, Kano, Sokoto and Jigawa state in Nigeria [5]. It is the sixth cereal crop in terms of world agriculture production with an annual production of about 29 million tonnes in 2013 [6].

Millet has been termed as "nutri-cereals" because they are rich in vitamins and sulphur containing amino acids. It has a low glycemic index and is gluten free, allergy friendly food which makes it an excellent choice for people suffering from celiac disease due to gluten intolerance [7]. Thus, the presence of all the required nutrients in the varieties of millet makes them suitable for large-scale utilization in the manufacture of flour.

Cake is one of the relished and palatable baked products prepared from wheat flour, sugar, shortening, baking powder, egg, and essence as principal ingredients [8]. They are a major snack in the fast food industry and are highly cherished by women and children [9]. Preparation of plain cakes from wheat flour is the conventional practice however, in tropical countries, wheat production is limited and importation of wheat flour to meet local demand is a necessity [10].

Efforts have been made to promote the use of composite flour in which locally grown crops with high protein value replaces a portion of wheat flour thereby decreasing the demand for imported wheat [10]. Hence, the aim of the study is to evaluate the effect of millet flour inclusion on the sensory and proximate composition of cakes.

2. Materials and Methods

2.1. Collection of Samples

Millet varieties were purchased from Bori-camp market, Port-Harcourt and cake ingredients (margarine, eggs, granulated sugar, salt and baking powder, vanilla, baking fruit, ground nutmeg) purchased from the local Mile 3 Market in Port-Harcourt, Rivers state, Nigeria.

2.2. Chemicals

Chemicals used for analysis were of analytical grade and used according to standard methods.

2.3. Methods

2.3.1. Processing of Millet Flour

The method of Olapade *et al*, [11] was used. Millets were manually cleaned by washing in clean water using local calabash and decanted by sedimentation, drained and dried in cabinet drier at 50°C for 6 h. The resulted dried millets were milled into flour using hammer mill (2014 hot model PC 120) and sieved to pass through 0.2mm mesh size.

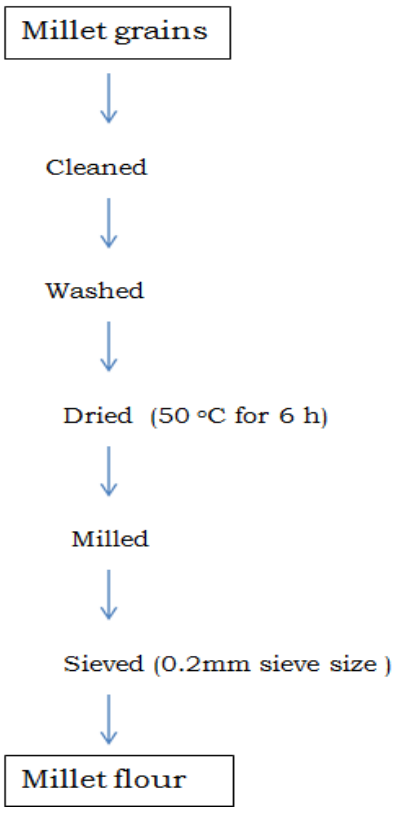

Figure 1. Production of Millet Flour (Source: [11])

2.3.2. Formulation of Blends

Wheat flour was substituted with the different varieties of millet flour at levels of 0% - 40% and 100% respectively. 100% wheat flour (sample A) was used as control. A kenwood mixer (model KMC011) was used for mixing flour samples for five minutes to achieve a homogenous mixture.

2.3.3. Preparation of Cake

The method of Ceserani and Kinton [12] was adopted for preparation of cake. The margarine and sugar were creamed manually for 10 min in a stainless steel bowl until light and fluffy. The egg was beaten for 3 min and vanilla essence added. It was added to the creamed mixture gradually while beating continued. Flour samples from composite blends were separately sieved with salt and baking powder and gradually folded into the mixture with a metal spoon. It was mixed thoroughly until a soft consistency batter was formed. The batter was transferred to a six inch greased pan and baked in a preheated oven at 200°C for 30 min and a further 20 min at a reduced temperature of 170°C. A skewer was inserted into the centre of the cake to ascertain it is cooked. When cooked, the cakes were allowed to cool in the tin for 3 min before turning out on wire racks for further cooling and analysis.

2.4. Proximate Analysis of Wheat/Millet Cakes

Different wheat/millet cakes produced were subjected to the following analysis. The moisture content of the sample was determined using moisture analyzer model AMB-ML-50 at 105°C. Fat, protein, ash and crude fiber content of the samples were determined using AOAC [13] and carbohydrate calculated by difference method.

2.5. Sensory Characteristics

Cakes were subjected to sensory analysis within 24 h of production. The following attributes namely: color, flavor, texture and taste were accessed on the cake samples using a 9-point hedonic scale according to Ihekoronye and Ngoddy [14]. Panelists were given orientation on how to carry out the evaluation.

2.6. Statistical Analysis

All experiments and analyses were carried out in triplicates and the mean calculated. Data were subjected to analysis of variance (ANOVA) using a general linear model Wahua [15]. Duncan multiple range test was used to separate means where significant difference existed [16].

3. Results

3.1. Proximate Composition of Cake from Blends of Wheat/ Millet Varieties

Table 1, Table 2 and Table 3 shows the proximate composition (%) of cakes produced from different

varieties of millet. Moisture content of the cakes ranged between 15.90% - 19.15%, 15.61- 19.15% and 12.52-19.65% with the 100% wheat cake as the highest in all cases. The present study showed that moisture content reduced with increase in the substitution of the various millet varieties. This means that cakes with millet had the possibility of having extended shelf life. This report is lower than the earlier study by Eke-Ejiofor and Bivan [17] of 18.00-22.20% for cake produced from acha, soybean and groundnut blends, while ash content ranged between 1.00% to 2.05% for pearl, 1.90% to 2.49% for finger and 0.70% to 2.05% for fonio millet cake respectively. The finger millet cake had the highest ash value, though ash content increased with an increase in substitution of millet for wheat. This result is in agreement with the findings of Eke-Ejiofor and Bivan [17], who reported ash content of 1-59-2.34% for acha based cake.

Fat content ranged between 18.00% in sample A (100% wheat cake) to 18.67% in sample PE (60% WF:40%PF), 15.91% in sample FF (100% finger millet cake) to 18.00% in sample A (100% wheat cake) and 14.90% in sample F (100% fonio) to 18.00% in sample A (100%Wheat**).** The fat result in the present study is lower than 19.77-23.73% reported by Eke-Ejiofor and Bivan [16] for acha based cake.

Protein content for pearl millet cake ranged between 5.75% in sample A (100% wheat cake) as the lowest to 13.16% in sample PE (60%WF:40%PF) as the highest**,** finger millet cake ranged between 5.75% in sample A (100% wheat cake) as the lowest to 11.85% in sample FE (6o%WF:40%FF) as the highest and fonio millet cake between 5.35% in sample B (90% WF:10%F) as the lowest to 10.54% in sample E (6o%WF:40%F) as the highest. Result showed that protein content increased with increase in substitution of millet, with the pearl millet cake having higher value than finger and fonio millet cake.

Crude fibre content for pearl millet cake ranged between 1.32% in sample PD (70% WF: 30% PF) to 2.00% in sample PE (60% WF: 40% PF), for finger millet cake-1.67% in sample A (100% wheat cake) to 3.00% in sample FF (100% finger millet cake) and for fonio cake- 0.68% in sample F (100% fonio millet) to 1.67% sample A (100% wheat cake).

Carbohydrate content of pearl millet cake ranged from 44.72% in sample PF (100% pearl millet) as the lowest, to 51.72% in sample PE (60%WF:40%PF) as the highest, while finger millet cake ranged between 43.51% in sample F (100% finger millet) as the lowest to 51.15% in sample FD (70%WF:30%FF) as the highest and 34.34% in sample F (100% fonio millet cake) as the lowest to 48.83% in sample D (70%WF:30%AF) the highest.

Generally, the result obtained shows a general increase in nutritional values of the cake samples compared to the control sample (PA, FA and A). Increase in substitution of millet flours increased the nutritional value of the cake. The findings of this work falls in agreement with Kwaw *et al*, [18] which reported that increase in substitution of millet flours in the blend increased the nutritional value of the cake as compared to the control (wheat flour). The proximate analysis for the different cake showed a significant difference ($p<0.05$) in all its parameters.

Table 1. PROXIMATE COMPOSITION (%) OF WHEAT /PEARL MILLET CAKE

Sample	Moisture	Ash	Fat	Protein	Crude Fibre	CHO
A	19.15^{a}	2.05^{a}	18.00^{c}	5.75^{e}	1.67^{b}	46.36^{b}
PB	17.65^{b}	1.59^{ab}	18.30^{b}	7.51^{c}	1.41^{c}	46.46^{b}
PC	17.54^{bc}	1.00^{b}	18.54^{a}	11.82^{b}	1.38^{d}	50.28^{a}
PD	17.06^{c}	1.00^{b}	18.66^{a}	11.85^{b}	1.32^{d}	49.87^{a}
PE	16.86^{c}	1.05^{b}	18.67^{a}	13.16^{a}	2.00^{a}	51.72^{a}
PF	15.90^{d}	1.50^{a}	18.14^{bc}	7.50^{d}	1.68^{b}	44.72^{c}
LSD	0.74	0.76	0.82	0.82	0.86	1.39

Means with different superscript in the same column are significantly ($p<0.05$) different.
Keys
A = 100% Wheat flour; PB= 90% wheat flour: 10% pearl millet flour; PC= 80% wheat flour: 20% pearl millet flour; PD= 70% wheat flour : 30% pearl millet flour PE= 60% wheat flour: 40% pearl millet flour; PF = 100% pearl millet flour

Table 2. PROXIMATE COMPOSITION (%) OF WHEAT/ FINGER MILLET CAKE

Sample	**Moisture**	**Ash**	**Fat**	**Protein**	**Crude Fibre**	**CHO**
A	19.15^{a}	2.05^{bc}	18.00^{a}	5.75^{d}	1.67^{d}	46.36^{c}
FB	18.25^{b}	1.90^{c}	17.66^{b}	5.75^{d}	2.34^{c}	47.45^{bc}
FC	17.00^{c}	2.00^{bc}	17.61^{c}	10.08^{c}	2.32^{c}	49.00^{ab}
FD	18.21^{d}	2.10^{bc}	17.46^{d}	10.80^{b}	2.61^{b}	51.16^{a}
FE	15.61^{d}	2.29^{ab}	17.24^{e}	11.85^{a}	2.66^{b}	49.65^{a}
FF	16.35^{cd}	2.49^{a}	15.91^{f}	5.76^{d}	3.00^{a}	43.51^{d}
LSD	0.75	0.36	0.04	0.66	0.06	2.63

Means with different superscript in the same column are significantly ($p<0.05$) different.
Keys
FA = 100% Wheat flour; FB= 90% wheat flour: 10% finger millet flour; FC= 80% wheat flour: 20% finger millet flour; FD= 70% wheat flour: 30% finger millet flour; FE= 60% wheat flour: 40% finger millet flour; FF = 100% finger millet flour

Table 3. PROXIMATE COMPOSITION (%) OF WHEAT/FONIO MILLET CAKE

Sample	Moisture	Ash	Fat	Protein	Crude Fibre	CHO
A	19.15^{a}	2.05^{a}	18.00^{a}	5.75^{c}	1.67^{a}	46.62^{e}
B	17.05^{b}	1.00^{c}	16.08^{e}	5.35^{c}	1.64^{a}	41.11^{d}
C	19.01^{a}	1.40^{b}	16.54^{d}	8.59^{b}	1.65^{a}	47.18^{bc}
D	19.06^{a}	1.40^{b}	16.73^{c}	10.31^{a}	1.34^{b}	48.83^{a}
E	19.65^{b}	1.00^{c}	17.46^{b}	10.54^{a}	1.34^{b}	47.64^{b}
F	12.52^{c}	0.70^{d}	14.90^{f}	5.55^{c}	0.68^{d}	34.34^{e}
LSD	0.75	0.36	0.10	0.73	0.03	0.64

Means with different superscript in the same column are significantly ($p<0.05$) different.

Keys

A = 100% Wheat flour; B= 90% wheat flour: 10% fonio millet flour; C= 80% wheat flour: 20% fonio millet flour; D= 70% wheat flour: 30% fonio millet flour; E= 60% wheat flour: 40% fonio millet flour; F = 100% fonio millet flour.

3.2. Sensory Evaluation Result for Cake from Blends of Wheat /Millet Varieties.

Table 4, Table 5 and Table 6 shows the sensory attributes of cake from blends of wheat and millet .Color for wheat/pearl millet cake ranged from 4.60-8.05 with sample A (100% wheat cake) as the most ad preferred and sample PF (100% pearl millet) the least preferred. Finger millet cake ranged from 3.65-8.30 with sample A (100% wheat flour) as most preferred and sample FF (100% finger millet) least preferred while fonio millet cake ranged from 5.65-7.80 with sample A (100% wheat cake) as most preferred and sample F(100% fonio millet) the least preferred.

Appearance ranged between 5.10-7.80 in sample A as most preferred while sample PF ((100% pearl millet) the least preferred. Appearance for finger millet cake ranged from 3.10-8.05 with sample A as the most preferred while sample FF (100% finger millet) as the least preferred and fonio millet cake ranged.

Flavor ranges from 5.05-7.90 in sample A as most preferred while sample PF as the least. Finger millet cake had flavor ranging between 4.30-7.70 with sample A as most preferred while sample FF (100% finger millet) the least, while fonio ranged from 5.15-7.80 with sample A being the most preferred while sample F the least.

Texture ranged from 5.60-7.50 for pearl millet cake with sample A as the most preferred while sample PF the least. Finger millet cake ranged between 3.90-7.60 with sample A as most preferred and sample FF(100% finger millet) the least, while fonio millet cake had 4.80-7.55.

Taste of cake samples ranged from 5.10-8.00 for pearl millet cake with sample A as most preferred while sample PF as least. Finger millet cake had taste ranging from 4.35-7.75 while fonio ranged from 5.65-7.80 with sample A as most preferred and sample FF(100% finger millet) and F as the least preferred.

Table 4. Mean sensory scores of cake produced from wheat/ pearl millet composite flour

Sample	Color	Appearance	Flavor	Texture	Taste	Overall acceptability
A	8.05^{a}	7.80^{a}	7.90^{a}	7.50^{a}	8.00^{a}	7.86^{a}
PB	7.45^{ab}	7.50^{ab}	7.55^{ab}	7.50^{a}	7.65^{a}	7.55^{a}
PC	6.65^{bc}	6.80^{b}	6.95^{bc}	6.50^{bc}	7.15^{ab}	6.79^{b}
PD	6.60^{c}	6.65^{b}	6.55^{c}	6.50^{bc}	6.40^{bc}	6.49^{b}
PE	5.95^{c}	6.55^{b}	6.60^{c}	6.60^{ab}	6.10^{c}	6.41^{b}
PF	4.60^{d}	5.10^{c}	5.05^{d}	5.60^{c}	5.10^{d}	5.10^{c}
LSD	0.84	0.88	0.82	0.90	0.86	0.69

Means with different superscript in the same column are significant different ($p<0.05$)
Key:
A = 100% Wheat flour; PB = 90% wheat flour: 10% pearl millet flour; PC = 80% wheat flour: 20% pearl millet flour; PD = 70% wheat flour: 30% pearl millet flour; PE = 60% wheat flour: 40% pearl millet flour; PF = 100% pearl millet flour.

Table 5. Mean sensory scores of cake produced from wheat/ finger millet composite flour

Sample	Color	Appearance	Flavor	Texture	Taste	Overall acceptability
A	8.30^{a}	8.05^{a}	7.70^{a}	7.60^{a}	7.75^{a}	7.89^{a}
FB	7.10^{b}	7.00^{b}	7.00^{ab}	6.85^{a}	6.75^{b}	7.04^{b}
FC	6.00^{c}	6.10^{b}	6.60^{b}	6.85^{a}	6.75^{ab}	6.54^{b}
FD	5.20^{cd}	5.20^{cd}	6.25^{bc}	5.95^{b}	5.95^{bc}	5.87^{c}
FE	4.55^{d}	5.00^{d}	5.70^{c}	5.55^{b}	5.30^{c}	5.22^{d}
FF	3.65^{e}	3.10^{e}	4.30^{d}	3.90^{c}	4.35^{d}	4.09^{e}
LSD	0.87	0.95	0.84	0.86	0.92	0.62

Means with different superscript in the same column are significant different ($p<0.05$)

Table 6. Mean sensory scores of cake produced from wheat/ fonio millet composite flour.

Sample	Color	Appearance	Flavor	Texture	Taste	Overall acceptability
A	7.80^{a}	7.85^{a}	7.80^{a}	7.55^{a}	7.80^{a}	7.86^{a}
B	7.00^{ab}	7.40^{a}	7.10^{a}	6.40^{bc}	7.00^{ab}	7.20^{ab}
C	7.40^{a}	7.40^{a}	7.30^{b}	7.10^{a}	7.40^{ab}	7.24^{ab}
D	6.95^{ab}	6.45^{b}	6.75^{b}	6.85^{ab}	6.95^{ab}	6.73^{bc}
E	6.50^{b}	6.30^{b}	6.60^{b}	6.20^{ab}	6.50^{bc}	6.39^{c}
F	5.65^{b}	5.25^{c}	5.15^{c}	4.80^{d}	5.65^{c}	5.20^{d}
LSD	0.86	0.89	0.84	0.93	0.86	0.66

Means with different superscript in the same column are significant different ($p<0.05$)
Key:
AA = 100% wheat flour; AB = 90% wheat flour: 10% fonio millet flour. AC = 80% wheat flour: 20% fonio millet flour; AD = 70% wheat flour: 30% fonio millet flour; AE = 60% wheat flour: 40% fonio millet flour; AF = 100% fonio millet flour; CHO= Carbohydrate.

Overall acceptability ranged from 5.10-7.86 for pearl millet cake, 4.09-7.89 for finger millet cake and 5.20-7.86, for fonio millet cake. In the three varieties, sample A (100% wheat cake) was most preferred and the 100% millet cake the least.

Generally, sample A (100% wheat cakes) were the most preferred though substitution up to 40% millet flour were generally acceptable for the cakes. The bright, acceptable color and appearance in pearl and fonio containing cakes may be attributed to the creamy color of pearl and fonio millet seed/grain, while finger millet presented a good taste and chocolate cake that could avoid the use of color additive in chocolate based cakes. Sensory analysis result showed a significant difference ($p>0.05$) in all parameters.

4. Conclusion

Results of this study has shown the possibility of producing cake of acceptable quality from wheat based composite flours containing millet varieties (pearl millet, finger millet and fonio millet).From this findings, it may be inferred that millet flours (pearl millet, finger millet and fonio millet) can be added to confectionaries (cake) up to 40% without significant adverse effects regarding color, aroma, taste and texture. Millet flours supplemented in the different cake samples were more acceptable nutritionally as they contain significantly more protein, fat and crude fibre. It was also concluded that cake produced from different millet cakes supplemented up to 40% were acceptable.

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